Hadronic $B$ decays in early Belle II data

Eldar Ganiev, Niharika Rout, and Benedikt Wach, for the Belle II Collaboration

1University of Trieste & INFN, Trieste, Italy, 2Indian Institute of Technology, Madras, India, 3Max Planck Institute for Physics, Munich, Germany

18th International Conference on B-physics at Frontier Machines – Ljubljana, Slovenia, Sep 30 – Oct 4, 2019

Seeking possible extensions of the Standard Model at 10–100 TeV is the chief goal of today's particle physics.

Belle II hadronic $B$ program has key role in indirect searches

- Reach ~2' precision on $\alpha/\rho$ to tighten CKM constraints
- Probe non-SM CPV in penguin-dominated $b \to s$ and $b \to d$ transitions as $B^0 \to \pi^0 K^0$ and $B^0 \to \phi K^0$.

Use hadronic $B$ decays in early data to validate Belle II performance

Belle II at SuperKEKB

Goal: collect > 50 billion $B\bar{B}$ pairs (50x full Belle data set)
- low background
- known collision energy
- coherent $B\bar{B}$ evolution

First data with complete detector in Mar-Jun 2019 $\equiv$ 6.5 fb$^{-1}$ (5.15 fb$^{-1}$ on-resonance), $L_{\text{peak}} = 1.2 \times 10^{34}$ cm$^{-2}$s$^{-1}$ (2% of final target)

B$\to$D$^0(K_S\pi^+\pi^-)\pi^-$

Golden channel for $\gamma/\rho_3$.

Results

- B$\to$DK
- B$\to$D$^0K^+$

Beam energy spread

Determine beam-energy spread from $M_{K_S}$: $\sqrt{E_{beam}^2 - P_K}$

- Belle II: at the forefront of indirect exploration of non-SM physics
- Key role for hadronic $B$ decays
- Mid-2019: first 6.5 fb$^{-1}$ of data with complete detector offer detailed validation of performance
- 4500 $B\to D^0\gamma$ reconstructed in 5.15 fb$^{-1}$
- First observation of suppressed $B\to DK$ decay in Belle II
- First observation of charmless $B$ decays in Belle II
- Beam energy controlled to < 3 MeV
- Remarkable performances — Belle II is ready for physics

First charmless signal from Belle II - new for BEAUTY!